MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The REVIEW for January, 1897, is based on 2,748 reports from stations occupied by regular and voluntary observers, classified as follows: 137 from Weather Bureau stations; numerous special river stations; 33 from post surgeons, received through the Surgeon General, U. S. Army; 2,435 from voluntary observers; 96 received through the Southern Pacific Railway Company; 14 from Life-Saving stations, received through the Superintendent United States Life-Saving Service; 33 from Canadian stations; 1 from Hawaii; 30 from Mexican stations. International simultaneous observations are received from a few stations and used together with trustworthy newspaper extracts and special reports.

The WEATHER REVIEW is prepared under the general editorial supervision of Prof. Cleveland Abbe. Unless otherwise specifically noted, the text is written by the Editor, but the meteorological tables contained in the last section are furnished by Mr. A. J. Henry, Chief of the Division of Records and Meteorological Data. Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada, Mr. Curtis J. Lyons, Meteorologist to the Government Survey, Honolulu, and Dr. Mariano Bárcena, Director of the Central Meteorological Observatory of Mexico.

CLIMATOLOGY OF THE MONTH.

GENERAL CHARACTERISTICS.

Several severe general storms occurred during the month, the notable ones were that which passed from the Lake Region on the 22d to the Gulf of St. Lawrence on the 26th, and that which passed from Florida on the 26th to New England on the 28th. Although pressures reduced to sea level were very high in the western Canadian Provinces and the Missouri Valley, yet only cold waves but no remarkable blizzards occurred in the Mississippi Valley. Generous snowfall covered the northern portion of the country and the winter wheat is, therefore, in very good condition. An unusual amount of rainfall occurred in southern California where the crops have been correspondingly benefited. Temperature, with severe cold waves, was below normal on the Gulf and south Atlantic coasts, but the cold did considerably less damage to vegetation than was anticipated. Precipitation was deficient in northern California, Washington, and Oregon, but the weather was otherwise favorable for agricultural operations.

ATMOSPHERIC PRESSURE.

[In inches and hundredths.]

The distribution of mean atmospheric pressure reduced to sea level, as shown by mercurial barometers, not reduced to standard gravity, and as determined from observations taken daily at 8 a. m. and 8 p. m. (seventy-fifth meridian time), is shown by isobars on Chart IV. That portion of the reduction to standard gravity that depends on latitude is shown by the numbers printed on the right-hand border.

The *mean pressures* during the current month were high throughout the ridge extending from the Rocky Mountain plateau region southeast to the Gulf States. They were low over Newfoundland and the Gulf of California. The highest reduced pressures were: In the United States, Lander, 30.35; Idaho Falls, 34.34; Helena, 30.31; in Canada, Battleford, 30.25; Edmonton and Swift Current, 30.22. The lowest were: In the United States, Eastport and Portland, Me., 30.00; Sault Ste. Marie, Marquette, and Fort Canby, 30.02; Tatoosh Island and Phœnix, 30.03; in Canada, St. Johns, 29.84; Sydney, Charlottetown, and Father Point, 29.94.

As compared with the normal for January, the mean pressure was in excess over the Plateau region, southern Slope, Gulf and South Atlantic States. It was deficient in California, Oregon, the northern portion of the Lake Region and the St. Lawrence Valley. The greatest excesses were: In the United States, Helena, 0.19; Lander 0.13; Spokane, 0.11; Idaho Falls and Cheyenne, 0.10; in Canada, Edmonton, 0.09; Swift Current and Qu'Appelle, 0.04; Medicine Hat, 0.03. The greatest deficits were: United States, Roseburg, 0.06; San Diego and Portland, Me., 0.05; Fresno and Marquette, 0.03; Canada, Port Arthur and Farther Point, 0.06; Port Stanley and Quebec, 0.04; Montreal and Calgary, 0.03.

As compared with the preceding month of December, the pressures reduced to sea level show a rise over the northern Plateau and the northern and middle Slope regions, but a fall over the Lake Region, the Atlantic States, California, and the Southern Plateau. The greatest rises were: United States, Havre, 0.22; Helena, 0.18; Medicine Hat, 0.17; Canada, Edmonton, 0.27; Medicine Hat, 0.25; Battleford and Calgary, 0.24. The greatest falls were: United States, Northfield, 0.18; Oswego, 0.11; Sault Ste. Marie, 0.10; Canada, Port Stanley, 0.14; Kingston, 0.12; Montreal, 0.11.

AREAS OF HIGH AND LOW PRESSURE.

By Prof. H. A. HAZEN.

During January, 1897, six high areas and nine lows have been sufficiently well defined to be traced on Charts I and II. The position of the center of high or low for 8 a. m. and 8 p. m. of

each day is given and also the barometer reading near the center. It should be noted that this barometer reading does not indicate always the highest and lowest pressure at the center, but the one which is observed at the station nearest the center. The accompanying table gives the principal facts as to the place of origin and disappearance, the duration and velocity of these highs and lows, and a few general remarks are added.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	1, a. m.	53	111	3, a. m.	44	110	740	2.0	372	15.5
II	11, a. m.	51	106	14, a. m.	47	72	1,870	3.0	624	26.0
III	13, a. m.	53	105	15, p. m.	47	65	1,830	2.5	732	30.5
IV	16, p. m.	48	121	19, a. m.	36	85	2,290	2.5	917	38.2
V	18, a. m.	50	98	21, a. m.	47	57	2,100	3.0	700	29.2
VI	27, p. m.	42	106	31, p. m.	40	73	2,340	4.0	585	24.4
Total							11,170	17.0	3,930	
Mean of 6 tracks							1,862	2.8	655	27.3
Mean of 17.0 days									657	27.4
Low areas.										
I	1, a. m.	31	101	6, p. m.	49	60	2,760	5.5	502	20.9
II	7, a. m.	53	118	13, a. m.	47	54	3,890	6.0	648	27.0
III	11, p. m.	52	115	14, a. m.	38	85	1,990	2.5	797	33.2
IV	14, a. m.	52	112	16, a. m.	50	79	1,490	2.0	744	31.0
V	15, p. m.	52	116	19, a. m.	49	53	3,400	3.5	702	40.5
VI	17, p. m.	51	111	20, a. m.	50	85	1,300	2.5	521	21.7
VII	19, a. m.	26	98	22, a. m.	47	63	2,480	3.0	828	34.5
VIII	19, p. m.	48	128	26, a. m.	49	66	4,540	6.5	697	29.0
IX	26, a. m.	26	85	30, a. m.	46	54	2,330	4.0	582	24.2
Total							24,180	35.5	6,291	
Mean of 9 tracks							2,687	3.9	699	29.1
Mean of 35.5 days									681	28.4

HIGHS.

These have had but little motion, the high pressures of the month being mostly stagnant phenomena in the middle Plateau Region.

The month opened with a high to the north of Montana. On the same day in the p. m. this high began spreading south and southwest. On the morning of the 2d this high had spread over the territory from the limits of observation at the north to Nevada and Colorado on the south, and from the Pacific Coast to the eastern Rocky Mountain Slope. For the next three days this condition remained nearly unchanged. On the 4th, a. m., this high concentrated in the middle Plateau Region, with a slight tendency to a flow of air or to a spread of the high pressure toward the south and southeast, reaching even to the Gulf of Mexico. On the 6th the high pressure tendency had spread to the southeast, reaching the Atlantic Coast p. m. of this day. On the 8th, a. m., there was a well-defined ridge of high pressure extending from the north Pacific Coast to the west Gulf, and thence to the south Atlantic Coast where it turned northeast and finally passed off beyond the region of observation north of the Gulf of St. Lawrence. This ridge of high pressure was broken through in its northern extension by low area No. II, 9th, p. m., but the remainder of the ridge could be easily located till the 11th, p. m. The tendency of this ridge was to diminish the intensity of storm conditions which were prevailing in the northern part of the country east of the Mississippi.

IV.—On p. m. of the 16th a high appeared in Washington and moved to the middle Plateau Region. A portion of this high remained in the middle Plateau Region until the 23d, a. m., and another portion behaved almost exactly like No. I, already described.

On p. m. of the 21st another high pressure area appeared to the north of Montana and remained there, gradually increasing in magnitude. On a. m. of the 24th a reduced pressure of 31.52 was reported from Medicine Hat, which is the highest ever reported from there. There was a tendency to a gradual extension of the high pressure toward the southeast, but no movement could be detected till the 27th, p. m., when high No. VI developed in southeast Colorado. On the 29th, a. m., this high pressure area seems to have concentrated in the lower Mississippi Valley. From that region there was a slight forward movement, the high reaching the middle Atlantic coast on the last day of the month.

During the month all the high area conditions may be denominated as almost entirely passive, only slightly modifying storm conditions which developed to the north of Montana and had a prominent locus or common point of attraction in the Gulf of St. Lawrence.

LOWS.

Six of the lows of the month were last noted in the Gulf of St. Lawrence or near there. The month opened with a trough of low pressure extending from Texas to Minnesota. This condition was well formed till p. m. of the 3d, when the high pressure in the Plateau Region filled in behind as the storm moved to the eastward. A wind velocity of 48 miles per hour was noted in this storm at St. Louis and Chicago on the 4th, p. m.

The most interesting storm of the month was No. VIII, which originated off the north Pacific Coast p. m. of the 19th. On this date a ridge of high pressure extended from the middle Plateau to the north of Montana, through which this storm passed. The pressure at Qu'Appelle a. m. of the 21st was 29.24. On the 22d, p. m., the storm had reached the lower Lake Region causing a wind of 52 miles per hour at Cleveland. During the next twelve hours a wind of 56 miles was noted at Buffalo. On the 23d, p. m., this storm reached the Gulf of St. Lawrence where it remained nearly stationary for forty-eight hours. On the 25th a. m. the pressure was 29.06 at St. Johns, Newfoundland, and the storm was between that point and Nova Scotia. It then moved west, causing the lowest pressure of the month, 28.86, at Father Point on the 26th, a. m. This is taken as the last point of the storm, though it is probable that it moved very rapidly across the Gulf of St. Lawrence eastward in the next twelve hours.

IX.—This storm was first noted to the west of southern Florida on the 26th a. m., with a pressure of 29.96. In forty-eight hours it had moved off Long Island Sound, increasing markedly in intensity, a pressure of 29.10, and a wind of 48 miles being reported from Block Island on the 28th, a. m. At 1 p. m. of the 28th the pressure reached 28.98 at Boston, and a wind of 56 miles was reported at Eastport. On the 28th, p. m., the wind had reached 68 miles per hour at Eastport, from the east. During the whole month the high areas presented stagnant, passive phenomena, while the lows were active and aggressive.

TEMPERATURE OF THE AIR.

[In degrees Fahrenheit.]

The mean temperature is given for each station in Table II, for voluntary observers. Both the mean temperatures and the departures from the normal are given in Table I for the regular stations of the Weather Bureau, which also gives the height of the thermometers above the ground at each station.

The *monthly mean temperatures* published in Table I, for the regular stations of the Weather Bureau, are the simple means of all the daily maxima and minima; for voluntary stations a variety of methods of computation is necessarily allowed, as shown by the notes appended to Table II.

The *regular diurnal period* in temperature is shown by the hourly means given in Table V for 29 stations selected

out of 82 that maintain continuous thermograph records.

The *distribution of the observed monthly mean* temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart IV; the lines are drawn over the Rocky Mountain Plateau region, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the country occupied by our observers; such isotherms are controlled largely by the local topography, and should be drawn and studied in connection with a contour map.

The *highest mean temperatures* were: In the United States, Key West, 67.6; Jupiter, 62.6; Tampa, 57.6; San Diego, 55.8; Yuma, 55.2; in Canada, Esquimault, 38.4; Yarmouth, 25.2; Kamloops, 26.4. The lowest were: In the United States, Moorhead, 2.0; Bismarck, 5.8; Duluth, 9.4; in Canada, Winnipeg, —3.0; Minnedosa, —2.4.

As compared with the normal for January the mean temperature for the current month was in excess throughout the Canadian Provinces and the northern portion of the United States. It was deficient in central California, the Middle and South Atlantic and Gulf States. The greatest excesses were: In the United States, Havre, 8.1; Spokane, 7.9; North Platte, 7.3; in Canada, Swift Current, 10.6; Minnedosa, 9.1; Qu'Appelle, 9.0. The largest deficits were: United States, Amarillo, 5.9; Columbia, S. C., and Jupiter, Fla., 4.4; Chattanooga, 4.1; Canada, none.

Considered by districts the mean temperatures of the current month show departures from the normal as given in Table I. The greatest positive departures were: North Dakota, 3.5; northern Slope, 3.9; middle Plateau, 3.0; northern Plateau, 4.2. The greatest negative departures were: South Atlantic, 3.3; Florida Peninsula, 2.9; southern Slope, 3.2.

The *years of highest and lowest mean temperatures* for January are shown in Table I of the REVIEW for January, 1894. The mean temperature for the current month was the highest on record only at Seattle: 39.1. The mean temperature was the lowest on record only at Amarillo, 27.6.

The *maximum and minimum temperatures* of the current month are given in Table I. The highest maxima were: 80, Jupiter (21st); 79, Key West (21st) and Los Angeles (22d); 78, Tampa and Palestine (1st); 76, Jacksonville (4th), Mobile (17th), Corpus Christi (2d), and San Antonio (1st). The lowest maxima were: 37, Moorhead (1st); 38, Williston (21st); 41, Huron and Idaho Falls (21st). The highest minima were: 51, Key West (29th); 40, San Francisco (11th) and San Diego (2d); 39, Yuma (16th) and Point Reyes Light (13th). The lowest minima were: —38, Havre (24th); —32, Williston (frequently); —30, Bismarck (24th); —29, Duluth (24th); —28, Moorhead (24th).

The *limits of minimum temperatures*, 32° and 40°, are shown by lines on Chart No. V.

The *years of highest maximum and lowest minimum temperatures* for January are given in the last four columns of Table I of the REVIEW for 1896. During the current month the maximum temperatures were equal to or exceeded the highest on record at: Dubuque and Davenport, 63; Miles City, 54: Green Bay, 51; St. Paul, 49; Sault Ste. Marie, 44. The minimum temperatures were equal to or exceeded the lowest on record at: Chicago, —20; Toledo, Detroit, and Pueblo, —16; Columbia, S. C., 10; Tampa, 29; Jupiter, 34.

The *greatest daily range of temperature and the data for computing the extreme and mean monthly ranges* are given for each of the regular Weather Bureau stations in Table I. The largest values of the greatest daily ranges were: Dodge City, 55; Helena, 54; Cheyenne, 51; Northfield, 50; Denver, 48; Pueblo, 47; Lander, 45. The smallest values were: Astoria, 14; Tatoosh Island and San Francisco, 15; Seattle and Key West, 16; Point Reyes Light and Pysht, 17; Port Angeles and Fort Canby, 18.

Among the *extreme monthly ranges* the largest were: Havre, 91; Dubuque, 86; Rapid City, 84; Miles City, Pueblo, Davenport, and Keokuk, 82; La Crosse, 80. The smallest values were: Tatoosh Island and San Francisco, 20; Point Reyes Light, 24; Sacramento, 26; Eureka and Key West, 28; Astoria, 29.

Accumulated monthly departures from normal temperatures for the period January 1 to 31, in regions where the temperature was deficient, the average deficit was as follows: Middle Atlantic, 1.8; south Atlantic, 3.3; Florida Peninsula, 2.9; east Gulf, 2.6; west Gulf, 0.3; Ohio Valley and Tennessee, 1.7; lower Lake, 0.8; southern Slope, 3.2.

In regions where the temperature was in excess, the averexcess was as follows: New England, 0.5; upper Lake, 2.5; North Dakota, 3.5; upper Mississippi, 1.0; Missouri Valley, 2.1; northern Slope, 3.9; middle Slope, 2.6; southern Plateau, 0.3; middle Plateau, 3.0; northern Plateau, 4.2; north Pacific, 1.9; middle Pacific, 0.2; south Pacific, 1.3.

MOISTURE.

The *quantity of moisture* in the atmosphere at any time may be expressed by the weight of the vapor coexisting with the air contained in a cubic foot of space, or by the tension or pressure of the vapor, or by the temperature of the dew-point. The mean dew-point for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, is given in Table I.

The *rate of evaporation* from a special surface of water on muslin at any moment determines the temperature of the wet-bulb thermometer. The mean wet-bulb temperature is now published in Table I; it is always intermediate, and generally about half way between the temperature of the air and of the dew-point. The quantity of water evaporated from the muslin surface may be considered as depending essentially upon the wet-bulb temperature, the dew-point, and the wind.

The *relative humidity*, or the ratio between the moisture that is present in the air and the moisture that it would contain if saturated at its observed temperature is given in Table I as deduced from the 8 a. m. and 8 p. m. observations. The general average for a whole day or any other interval would properly be obtained from the data given by an evaporometer, but may also be obtained, approximately, from frequent observations of the relative humidity.

PRECIPITATION.

[In inches and hundredths.]

The *distribution of precipitation* for the current month, as determined by reports from about 2,500 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III. The total precipitation for the current month exceeded 10 inches over a narrow region on the coast of Washington and Oregon and over small regions in Arkansas and Louisiana. The larger values for regular stations were: Tatoosh Island, 12.20; Astoria, 9.84; Fort Canby, 9.58; Little Rock, 8.51; Grand Haven, 7.99; San Luis Obispo, 5.22; Jupiter, 5.20. Canada: St. Johns, N. F., 11.40.

Details as to *excessive precipitation* for January are given in Tables XI and XII.

The *years of greatest and least precipitation* for January are given in the REVIEW for January, 1890. The precipitation for the current month was the greatest on record at: Little Rock, 8.51; Grand Haven, 7.99; Columbia, Mo., 6.87; Springfield, Mo., 6.47; Springfield, Ill., 5.91; Keokuk, 4.90; Chicago, 4.53; Phœnix, 3.67; Huron, 2.87; Yuma, 2.83; Kansas City, 2.66; Amarillo, 2.26; Pierre and Minneapolis, 1.66; Moorhead, 1.56; Sioux City, 1.41. It was the least on record at: Idaho Falls, 0.67; Cape Henry, 0.92; Kitty Hawk, 1.35;